NAVAL POSTGRADUATE SCHOOL

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THESIS

DETERMINING THE NUMBER OF REENLISTMENTS NECESSARY TO SATISFY FUTURE FORCE REQUIREMENTS

by

Jonathan D. Raymond

September 2006

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13. ABSTRACT (maximum 200 words)

The Manpower and Reserve Affairs Department (M&RA) of Headquarters Marine Corps currently uses two models to assist in determining the optimal number of reenlistments each MOS should record in each year. One is called the First Term Alignment Plan (FTAP) and the other is called the Subsequent Term Alignment Plan (STAP). As their titles suggest, the FTAP calculates reenlistment numbers for first-term Marines while the STAP performs the calculations for all other Marines. M&RA requested that these models be examined in an effort to combine the functionality of each. This thesis builds a model that does just that.

The fundamental concept of the model involves taking the current inventory of Marines (by military occupational specialty [MOS] and grade) and applying transition rates to each of them in order to determine how many are in what state at the end of the upcoming year. The necessary number of reenlistments is then calculated by subtracting the forecasted inventory from a desired force structure known as the Grade Adjusted Recapitulation. Manpower planners can use the results of this model to establish the number of boat spaces for each of the first-term MOSs as well as recommended reenlistment goals for the subsequent-term MOSs.

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DETERMINING THE NUMBER OF REENLISTMENTS NECESSARY TO SATISFY FUTURE FORCE REQUIREMENTS

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LIST OF ACRONYMS AND ABBREVIATIONS

CFRM	Career Force Retention Model
CNA	Center for Naval Analyses
ECC	Expiration of Current Contract
FTAP	First Term Alignment Plan
FY	Fiscal Year
GAR	Grade Adjusted Recapitulation
M&RA	Manpower and Reserve Affairs
MOS	Military Occupational Specialty
ODSE	Operational Data Store Enterprise
PMOS	Primary Military Occupational Specialty
SAS	*SAS System for Windows*, Release 8.02
SRB	Selective Reenlistment Bonus
SSN	Social Security Number
STAP	Subsequent Term Alignment Plan
TFDW	Total Force Data Warehouse
USMC	United States Marine Corps
YOS	Years of Service

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First, I would like to express my appreciation for the struggles my wife, Susan, underwent in order for this research to be completed. I am in awe of her patience as well as her ability to maintain a loving home.

To Captain Shaun Doheney: Thank you very much for the time you spent making travel arrangements and tutoring me on several aspects of USMC manpower planning.

Also, I am extremely grateful and indebted to Professor Ron Fricker for the level of effort he put into seeing this project through to completion.

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EXECUTIVE SUMMARY

The Manpower and Reserve Affairs Department (M&RA) of Headquarters Marine Corps currently uses two models to assist in determining the optimal number of reenlistments each MOS should have each year. One is called the First Term Alignment Plan (FTAP) and the other is called the Subsequent Term Alignment Plan (STAP). As their titles suggest, the FTAP calculates reenlistment numbers for first-term Marines while the STAP performs the calculations for all other Marines. Not only were these models built at different times and by different organizations, they also use different methodologies. M&RA has requested that these models be examined in an effort to combine the functionality of each into a single coherent model. This thesis builds a model that does just that.

The fundamental concept of the model involves taking the current inventory of Marines who are not entering an end-of-contract year (by military occupational specialty [MOS] and grade) and applying transition rates to each of them in order to determine how many are in what MOS and grade combination at the end of the upcoming year. This forecasted inventory is then subtracted from a desired force structure known as the Grade Adjusted Recapitulation. The resulting vector represents the necessary number of reenlistments for each MOS and grade.

Manpower planners are able to use the results of this model to both establish boat spaces for each of the first-term MOSs and to create the annual recommended reenlistment goals for the subsequent-term MOSs. Once the optimal number of reenlistments is determined, manpower planners can use this information to allocate the Selective Reenlistment Bonus budget and to decide where to allow MOS lateral transfers.

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I. INTRODUCTION

A. PURPOSE

This thesis develops a new method for determining the required number of reenlistments necessary to meet a pre-specified enlisted force structure. The research was conducted for the Manpower and Reserve Affairs Department (M&RA) of Headquarters, U. S. Marine Corps (USMC). M&RA currently uses two models to determine the required number of reenlistments: one for Marines who are in their first enlistment contract (referred to as "first termers") and another for all other Marines (referred to as "subsequent termers"). At M&RA's request, this research developed a single model that provides the number of required reenlistments for all Marines, regardless of their current contract number, by pay grade and military occupational specialty (MOS).

B. BACKGROUND

The first of the Marine Corps' original two models, called the First-Term Alignment Plan (FTAP), was developed in 1991 by the Center for Naval Analyses (CNA). It calculates the maximum number of first-term reenlistments by occupational field, which is the term used to describe broad groupings of MOSs. At the time the FTAP model was conceived, it was believed that force-shaping decisions only could be made at the end of the first term. This rationale was based on two observations. First, Congressional legislation required that monetary payments be awarded to subsequent termers if they were forced out of the service for reasons other than conduct or unsatisfactory performance (USC, Title 10). Additionally, the military personnel system requires that its members enter at the most junior levels and progress sequentially through the ranks with time. Hence, in an effort to conserve fiscal resources and prevent promotion stagnation, the majority of the force structure controls were placed at the end of the first term.

The initial run of the 1992 FTAP model provided "a solution for the number of first-term reenlistments required in the steady state if the YOS [years of service] 5 to 20 requirements for FY 1992 are steady-state requirements," (North

& Quester, 1992, p. 8). In today's rapidly changing environment it is questionable whether such steady-state assumptions are appropriate. In addition, it is difficult to know precisely what the authors meant by "steady-state" since the model documentation does not define it. Also, because the model was implemented in a complex Excel spreadsheet format, it is virtually impossible to "reverse engineer" the model "code" to understand what the model is doing.

In any case, the FTAP-created reenlistment thresholds were (and still are) referred to as "boat spaces," a name derived from the fact that Marines are placed on boats prior to fighting their way inland. Boat spaces only apply to Marines who are in the first term. The number of boat spaces available for a particular MOS is dependent on the reenlistment behavior of subsequent-term Marines and the future requirements for the MOS. For example, if the subsequent-term enlisted force in a particular MOS remain on active duty in greater numbers from one year to the next without a corresponding increase in the force structure, it will be necessary in the following year to decrease the number of boat spaces for that MOS in order to ensure the MOS is not overmanned. Conversely, if the next year's force requirements increase significantly for a particular MOS then it is likely that the boat spaces for that MOS will have to be increased in order to meet the new requirements.

Around 2000, Marine Corps planners recognized that since the first-term boat spaces are dependent on the number of subsequent-term reenlistments, something should be done to influence the reenlistment decisions of the more senior Marines as well. This thinking gave birth to the second of the two models currently in use, the Subsequent Term Alignment Plan (STAP). The STAP model was incorporated into the enlisted force planning process in 2002 and its goal is to determine the number of subsequent-term reenlistments by occupational field and Selective Reenlistment Bonus (SRB) zone needed to meet a future enlisted force structure. The STAP is different from the FTAP in that its output is not used for establishing thresholds. Instead, it is used to set reenlistment goals for the various Marine Corps major commands because subsequent-term Marines generally are not turned down for reenlistment unless they have associated conduct or performance issues.

The formulation of the STAP model is quite simple. It uses historical attrition data to determine a predicted force structure of career Marines. Then it compares this forecast to a future force requirement called the Grade Adjusted Recapitulation (GAR). When the forecasted inventory is greater than the GAR, respective reenlistment targets are decreased (though not to zero) which deemphasizes the number of reenlistments required. Conversely, when the forecasted inventory is less than the GAR, the respective reenlistment targets are increased; thereby emphasizing the fact that more reenlistments are necessary. This method changes career force inventory levels to better fit career force requirements without causing excessive overages or shortages.

Both the FTAP and STAP models are used in conjunction with the SRB Program model to shape the current force to meet future requirements. The SRB program offers a monetary reward to Marines who reenlist in MOSs that are critically undermanned. The output from the FTAP and STAP models is put into the SRB Program model which calculates the SRB budget distribution across MOS and SRB Zone (YOS groups) combinations. This results in specific reenlistment bonuses being offered to the appropriate MOSs.

This enlisted force-shaping system has been in use, at least in part, for approximately 14 years. The work in this thesis, combined with the total enlisted force prediction model found in Conatser’s thesis (2006), now provides Marine Corps manpower planners with a coherent series of models (together entitled the Career Force Retention Model or CFRM) that combine the functionality of the FTAP and STAP models and represent the entire enlisted force. In addition, the CFRM generates reenlistment requirements down to the MOS level.

C. RESEARCH GOALS

The goal of this thesis is to develop a new method for determining the number of reenlistments necessary to meet a pre-specified enlisted structure. In doing so, it must model Marines in both the first term and the subsequent term simultaneously. Ultimately, the output will offer manpower planners sound advice on the number of reenlistments, by MOS and grade combination, that should be authorized during the following fiscal year (FY).

D. SOFTWARE

The SAS System for Windows, Release 8.02 (SAS) was used throughout this research. In particular, it was used to:

- manipulate the TFDW data,
- model the transition behavior of Marines from one year to the next, and
- provide output for decision makers.

This software package was chosen for several reasons. First, it can quickly perform computationally intense operations on very large data sets. It also has the ability to perform statistical analysis and provide graphical output such as reports, tables, and graphs. Additionally, because the analysts at M&RA also use SAS, they will have the flexibility to modify the model to suit changing manpower policies and regulations. Finally, the annotated program code fully documents all of the data manipulation which will help prevent the model from being (or becoming) "black box" in nature.

E. THESIS OUTLINE

This thesis is written in an order similar to the way its subject model was derived. Chapter II examines some of the existing literature on military force shaping. Chapter III describes the data that was gathered to build the model as well as the techniques used establish a format to be used by the model. Chapter IV steps through the methodology of the model, while Chapter V provides the results for 2005 and an analysis of the output. Finally, Chapter VI concludes with some recommendations for future research.

II. RELATED WORK

A review of recent studies related to determining the right number of reenlistments in the Department of Defense revealed that research in the area is extremely limited. With this search, we are looking for research other than the previously mentioned development of the FTAP by CNA. The following few paragraphs discusses the three military manpower studies that were most applicable.

In 2001, Litzenberg developed a linear program that determines the optimal number of attritions, accessions, and promotions to allow in order to shape the Army Reserve's officer corps. It uses a transition network to model the flow of officers through the manpower system. Changes in state are composed of changes in any one of the following: time in grade, YOS, or grade. Ultimately, the model minimizes deviations from inventory targets while applying regulatory constraints on promotions, time in service, losses, and accessions (Litzenberg, 2001).

Another piece of literature reviewed for this thesis was Nguyen's 1997 examination of the Marine Corps' steady state Markov model that "forecast[s] the annual personnel classification requirements of new recruits" (Nguyen, p. v). This model involves applying annual transition rates over time to an initial inventory in order to forecast a future inventory. With each application of transition rates, additional inventory is added to the system to account for accessions. Nguyen found two flaws in the then-existing Marine Corps model: the estimates of the first year transition rates were not calculated correctly and the rounding errors in the model caused significant inaccuracy in the classification estimates. Furthermore, Nguyen rebuilt the model, correcting the mistakes he had found.

Lastly, we reviewed an article by DeWolfe et al. (1993) that developed a method of optimizing the distribution of an SRB budget in order to attain a particular force structure. More specifically, it uses a nonlinear integer program “to select multipliers which minimize a function of deviations from desired reenlistment targets” (DeWolfe et al., p. 143). Here, the term “multiplier” is referring to the level of bonus that will be received upon reenlistment. Although this model has been proven to be quite effective, the fact that it requires sophisticated and expensive solver software has caused M&RA to cease using it.

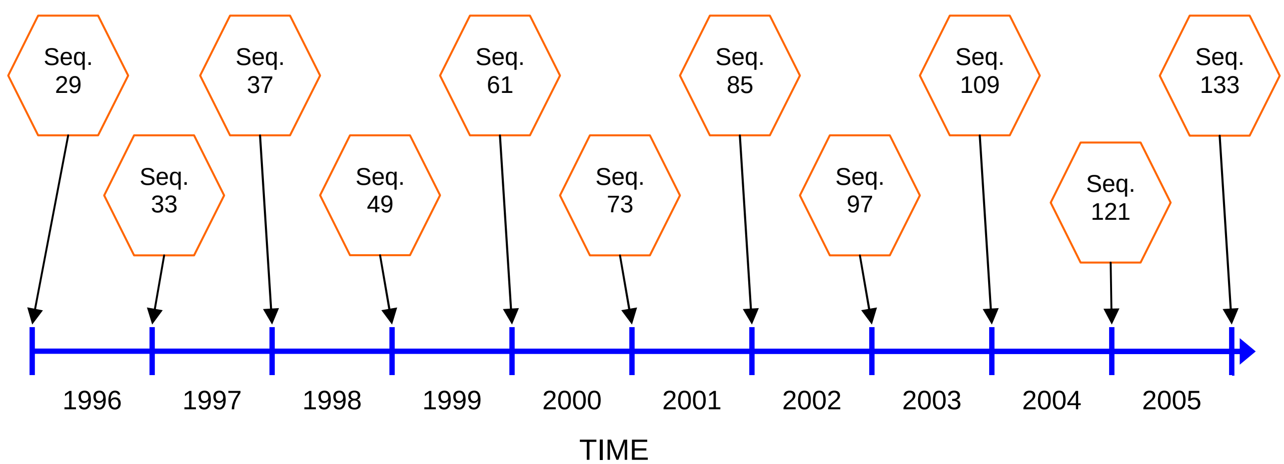
Each of the above mentioned studies have the same ultimate goal: to shape a subset of their respective total force structure. However, each of them uses a different driver to accomplish its mission. Litzenberg uses promotion, accessions, and losses; Nguyen uses transition rates based on historical data; and finally, DeWolfe et al. use reenlistment bonuses. The model described in this thesis is also an attempt at meeting a required force structure; however, it establishes the number of reenlistments necessary to do so. This approach is what differentiates this thesis from the studies noted in this literature review.

III. DATA

A. DESCRIPTION OF DATA PULL

The data used for this model was taken from the TFDW at Manpower and Reserve Affairs. The TFDW is a large database containing demographic, financial and service data for all personnel (active and reserve, officer and enlisted) in the Marine Corps. The data in the TFDW is comprised of historical “snapshots” of a more dynamic information system called the Operational Data Store Enterprise (ODSE). The ODSE is an Oracle 10g relational database that is updated every time a financial or service-related transaction is recorded on a Marine. In laymen’s terms, ODSE is the working copy of the data being kept while TFDW is the archived data of the past.

Figure 1. TFDW Sequence Numbers and their Associated Snapshot Date



The TFDW is a collection of ODSE snapshots taken on the last day of every month. Each of these snapshots is identified by a sequence number. In order to extract data from TFDW in a meaningful manner, a query must be filtered by a sequence number so that the user knows the period of time from which the data came. It is important to note that for this thesis, sequence numbers 29, 33, 37, 49, 61, 73, 85, 97, 109, 121, and 133 were used.[1] These correspond to the last day of fiscal years 1995 through 2005 (see Figure 1). Historical data from the last day of 1995 was necessary in order to ensure that first-term Marines could be distinguished from subsequent-term Marines. The details of this are explained in Chapter IV.

The software used to query the TFDW is called *Cognos Impromptu*, version 6.0. This software has a drag-and-drop graphical user interface that made it very easy to pull the same data for the 11 snapshots. Along with sequence number, the query we used also filtered for active duty and enlisted Marines to form the correct subset of the total population. For this subset, we queried the following service information:

- present grade
- primary MOS
- expiration of current contract (ECC)
- social security number (for a unique identifier)

We ran the query 11 times, once for each sequence number. This resulted in the formation of 11 data base files. An individual Marine could potentially be in all 11 files if he or she had been on active duty during all of the corresponding years. These files are the foundation of the data used to build the model examined in this thesis.

B. CONSTRUCTING A LONGITUDINAL DATABASE

At this point, the end-of-year snapshots of data were not in a format that would allow for creating more useful data. First, the database files had to be imported into the SAS, and thus, transformed into a "data set." Upon running the code to perform this,[2] it was discovered that there were duplicate observations in the 1999 through 2005 data sets. Specifically, there were 224 duplicates in the

[1] Note that the reason there is not equal spacing between the numbers in the list is because monthly snapshots were not initiated until fiscal year 1998 (or sequence number 37). Prior to that, the ODSE snapshots were taken on a quarterly basis.

[2] See Appendix, lines 13–28.

1999 data set and the number increased every year, with 1,703 duplicates in the 2005 data set. Upon some investigation, it was concluded that there was an issue with one of the data fields during the query. If an SSN had a value in the additional MOS field, then one or more duplicate observations were created.[3] To fix this, each duplicate was examined carefully to ensure that it was indeed a duplicate and not a data entry error; then it was deleted from its data set.

Next, the data sets had to be merged to form a single longitudinal database that contained all the data. This required that the field names (with the exception of SSN) be renamed so that they could be identified by their associated end-of-fiscal-year date.[4] Once the appropriate field names were made unique, the data sets were ready to be merged. This was done using the merge function of the SAS data step.[5] With this, a longitudinal data base was created that contained one record for every enlisted Marine that was in the Corps from the last day of FY 1995 to the last day of FY 2005. Each record contained a grade, an MOS, and an ECC for each year that the record was present. If the record was not present in a particular snapshot, the fields for that year were left blank.

All of the above mentioned procedures (the import of the data base files, the renaming of the field names, and the merge of the data sets) were performed using the *SAS System's* macro language. A macro is a method of running several iterations of a combination of the fundamental functions offered by SAS. Much like a loop, it significantly reduces the amount of code that must be written to perform a series of commands. The trademark of the macro code is that the functional syntax is preceded by a "%." This character is the syntax used to communicate with the macro processor of the *SAS System*.

[3] The additional MOS field was queried in the initial data pull because the author was uncertain what data would be of use in the development of this model.

[4] See Appendix, lines 35–56.

[5] See Appendix, lines 62–73.

C. DEVELOPING USEFUL DATA

Once the data was contained in a single longitudinal data set, new variables were created for use in the model.[6] Table 1 shows each of the fields and their associated definition. How these variables were used will be explained in Chapter IV.

Table 1. Definitions of Data Elements

Field	Definition
ECCFY[year]*	Binary variable that is a "1" if the observation ever has an ECC in during the associated fiscal year; zero, otherwise.
ECCFYTEST[year]*	Same as ECCFY[year]*. This a dummy variable used in the calculation of ECCTOTAL[yr]**.
NEWBIE[year]*	Binary variable that is a "1" if the observation is new to the system during the associated fiscal year; zero, otherwise.
MOSGRADE[year]*	String that represents the concatenation between PMOS[year]* and GRADE[year]* for the associated fiscal year.
TRANSITION[year]*	String that represents the transition from MOSGRADE[year-1]* to MOSGRADE[year]*.
ECCTOTAL[yr]**	The sum of all the ECCFYTEST[year]* values prior to the end of fiscal year "yr."

* [year] denotes a 4-digit year

** [yr] denotes a 2-digit year

D. OTHER DATA REQUIREMENTS

In addition to the historical personnel data, the GAR was required in the analysis. The GAR is a table of a future enlisted personnel inventory developed by M&RA operations analysts and used as a planning tool. For each grade and MOS, it accounts for manpower constraints such as budget, legislative regulations, and Marine Corps policies. A new GAR is formulated annually

[6] See Appendix, lines 77–179.

during the March-April timeframe and it represents the five-year-out desired structure of the Marine Corps' enlisted force (*Manpower 101*, 2005). For example, the 2005 GAR was produced during the Spring of 2000. This is the GAR that the model of this thesis attempts to meet by calculating a particular number of reenlistments.

Table 2 represents an excerpt from the 2005 GAR. It contains information for the 0311 MOS, Rifleman. Note that there are zeros in the E6 through E9 columns. This is because a Marine can only have the 0311 MOS until he is an E5. Upon reaching the E6 grade; his MOS automatically changes to 0369, Infantry Unit Leader. It is for this reason that Manpower planners define the 0311 MOS to be a "feeder" MOS. It (along with others) feeds into an MOS associated with a higher pay grade.

Table 2. Excerpt from FY2005 GAR

MOS 0311	E9	E8	E7	E6	E5	E4	E3	E2/1	TOTAL
ASR	0	0	0	0	1302	2365	7483	0	11150
TOTAL A-BILLETS	0	0	0	0	1302	2365	7483	0	11150
TOTAL B-BILLETS	0	0	0	0	454	507	1197	0	2158
TOTAL A+B BILLETS	0	0	0	0	1756	2872	8680	0	13308
NAR BILLETS	0	0	0	0	1756	2872	8680	0	13308
T2P2	0	0	0	0	88	170	0	0	258
NAR	0	0	0	0	1844	3042	8680	0	13566
GAR	0	0	0	0	1868	3084	8560	0	13512

(From M&RA 2005 GAR file)

There are two other characteristics of the GAR that are important to note. First, grades E1 and E2 do not receive positive inventory values for any of the MOSs. This is because the E1-E3 manning goals are aggregated in the E3 column. Secondly, the GAR contains additional information (e.g. ASR, TOTAL A-BILLETS, TOTAL B-BILLETS, etc.) used by M&RA analysts to formulate the GAR. However, they are not required for the calculation of required reenlistments and hence will not be explained here.

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IV. METHODOLOGY

Having established the necessary data fields in the previous chapter, we will now examine how the model uses this data to produce the necessary output. The basic idea of the model is to take an inventory of homogeneous Marines and apply transition rates to them to determine how many are in each state (MOS and grade) at the end of the following year. Although this sounds simple, the number of MOS and grade combinations is large and the calculations necessary to determine the inventory and the appropriate transition rates are nontrivial.

Note that the model only applies to Marines who do not have an ECC that falls during the following FY. These Marines represent the subset of the enlisted force that does not have the option to separate from the service. The reason the model only considers this subset is because it is calculating the expected personnel inventory for those Marines who cannot leave the service in order to determine the number of slots available to those who can reenlist in the next year. Thus, it cannot include Marines that are making the reenlistment decision as part of its inventory. For the remainder of this report, whenever the term "inventory" is used, it refers to the population of Marines who are not making a reenlistment decision during the following FY.

To simplify the presentation for those who desire to understand the model's code (contained in Appendix), the methodology of the model will be examined in the same order in which the SAS code was written.

A. THE THEORETICAL APPROACH

First, we will examine the methodology in mathematical terms. The main idea is that we want to predict what the inventory will be one year into the future. The first step in doing this is determining the one-year transition rates for each MOS and grade combination. In the absence of other information, we assume that the transition rates for the upcoming year are the same as the ones from the year prior. Hence, we build a transition matrix (A) whose states are MOS and grade combinations. The "From:" MOSGRADEs represent the rows and the

"To:" MOSGRADEs label the columns. The rate is the fraction of the "From:" MOSGRADE that transitioned into the "To:" MOSGRADE. See Figure 2 for an example.

Figure 2. Transition Matrix

$$
\begin{array}{cc}
 & \textbf{TO:} \\
 & \begin{array}{ccccc} \underline{3043E3} & \underline{3043E4} & \underline{3043E5} & \underline{3043E6} & \cdots \end{array} \\
\textbf{FROM:}\ \begin{array}{c} 3043E3 \\ 3043E4 \\ 3043E5 \\ 3043E6 \\ \vdots \end{array} &
\left[\begin{array}{ccccc}
0.48 & 0.45 & 0.01 & 0.00 & \cdots \\
0.03 & 0.51 & 0.46 & 0.00 & \cdots \\
0.01 & 0.02 & 0.61 & 0.36 & \cdots \\
0.00 & 0.00 & 0.01 & 0.67 & \cdots \\
\vdots & \vdots & \vdots & \vdots & \vdots
\end{array}\right]
\end{array}
= \boldsymbol{A}
$$

The next step involves building a vector containing the current inventory by MOS and grade combination (see Figure 3). Once this is done, we take the transpose of the MOSGRADE transition matrix (A^T) and multiply it by the current inventory vector (see equation (1)). The resulting vector represents the forecasted inventory of the Marines who are not currently entering a contract year. The elements in this vector correspond to the MOSGRADEs in the "To:" columns of the transition matrix.

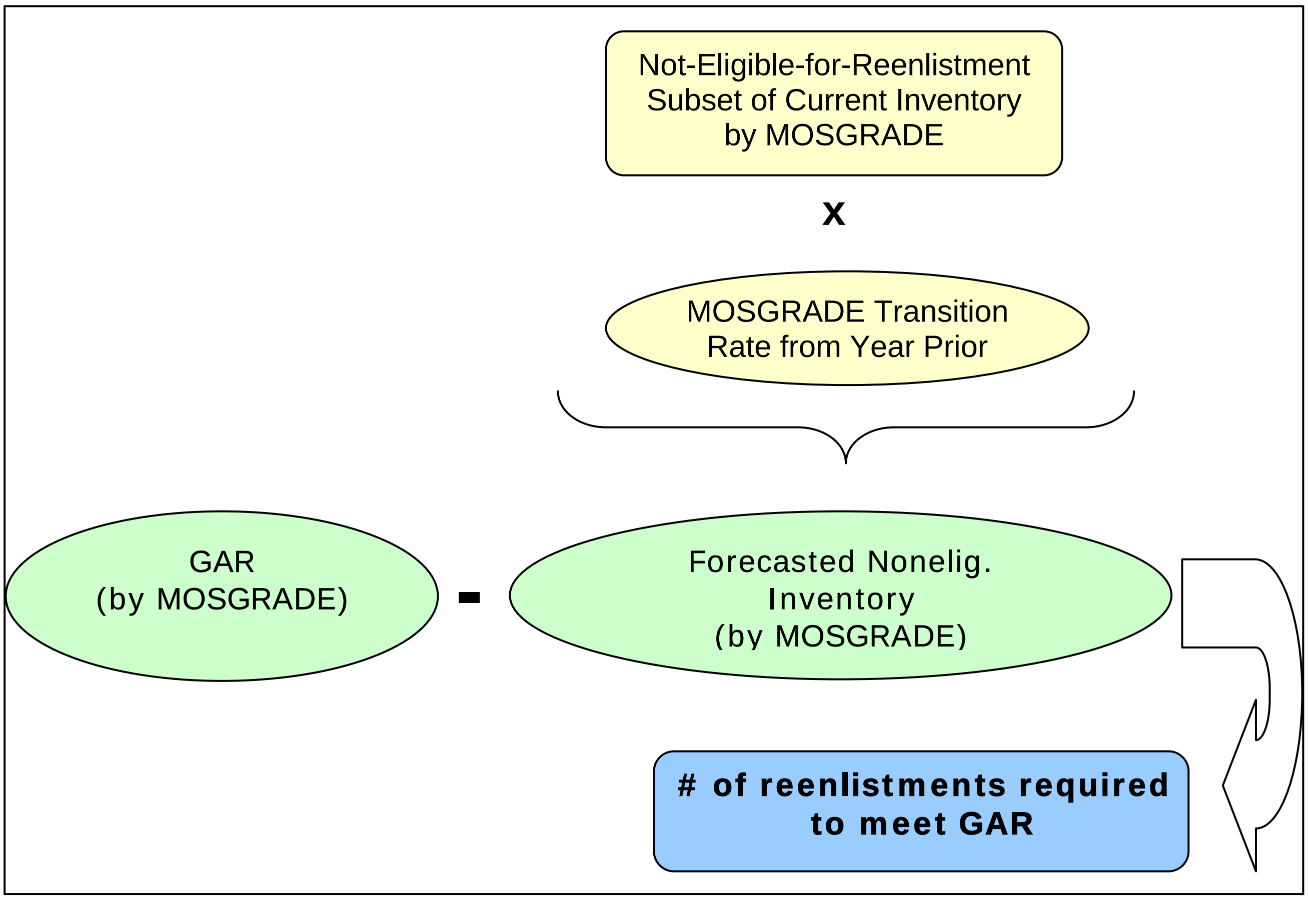
Figure 3. Inventory Vector

$$
\begin{array}{cc}
 & \textbf{Inventory} \\
\begin{array}{c} \vdots \\ 3043E3 \\ 3043E4 \\ 3043E5 \\ 3043E6 \\ \vdots \end{array} &
\left[\begin{array}{c} \vdots \\ 315 \\ 240 \\ 115 \\ 92 \\ \vdots \end{array}\right]
\end{array}
= \boldsymbol{V}
$$

$$\text{Forecasted Inventory} = A^T \cdot V \qquad (1)$$

Finally, the one-year-out enlisted force requirement (GAR) is placed into vector format (by MOS and grade combination) and we are now ready to perform the vector subtraction problem that calculates the necessary number of reenlistments (see Figure 4).

Figure 4. Methodology of the Model



B. THE SAS APPROACH

Having touched on the model's general methodology, we will now explain how the model was implemented to calculate predictions for 2005. The SAS application of the methodology requires scalar-vector arithmetic instead of the above-mentioned matrix-vector arithmetic. Although SAS has the capability to compute matrix operations, it does not have the capability to index the matrix using character strings. These indices are absolutely necessary in order to determine what each of the calculated transition rates refers to. Hence, the following is an explanation of the methodology as it was performed using SAS code.

1. Calculating Transition Rates Using SAS

The first step in the modeling process is to extract the above-mentioned subset of the population from the longitudinal data base. Since the model calculates transition rates first and the rates are calculated according to 2004 behavior, this inventory will include Marines who are in the system on the last day of 2003. The code used to extract this population from the longitudinal data base can be found in Appendix, lines 184–187 and 277–280.

Next, MOS and grade transition rates are calculated. This is done by taking the TRANSITION2004 data and sorting it by its associated MOSGRADE2003 (remember that TRANSITION2004 is a concatenation of MOSGRADE2003 and MOSGRADE2004). At this point, the model uses SAS's PROC FREQ to calculate the transition rates from each MOSGRADE2003 entry to its associated MOSGRADE2004.[7] Figure 5 provides an illustration of how the transition rates are calculated using actual data from the first run of the model.

2. Creating the Current Inventory Vector in SAS

Before the transition rates can be applied, a current force inventory vector must be produced. This vector must include the Marines who are in the service on the last day of FY2004 and who do not have an ECC during FY2005. This vector is produced by first pulling this subset from the longitudinal data base.[8] SAS's PROC FREQ is then used to count the cumulative number of Marines in each MOS and grade combination found in the subset.[9] The output is a data set containing the current inventory by MOS and grade.

[7] See Appendix, lines 197–200 and 287–290.

[8] See Appendix, lines 217–220 and 311–314.

[9] See Appendix, lines 228–230 and 322–324.

Figure 5. Determination of MOS & Grade Transition Rates (for MOSGRADE = 3052E7)

TRANSITION2004* (by individual)
3052E7 to 3052E7
3052E7 to 3052E7
3052E7 to 3052E7
3052E7 to 3052E8
3052E7 to 3052E7
3052E7 to 3052E7
3052E7 to 3052E7
3052E7 to 3052E7
3052E7 to 3052E7
3052E7 to 9999E8

TRANSITION2004 (grouped)	TRANSITION RATE
3052E7 to 3052E7	0.80
3052E7 to 3052E8	0.10
3052E7 to 9999E8	0.10

* The format for TRANSITION2004 is "MOSGRADE2003 to MOSGRADE2004"

3. Forecasting the Inventory of Marines Not Entering a Contract Year Using SAS

At this point, the critical information needed to make a prediction on the not eligible (for reenlistment) population has been gathered. The next step is to get this information into one data set. To do this, we use the MERGE function of the SAS DATA step which merges the data by MOSGRADE2003 (in the code, this field name has been changed to "STARTMG" to avoid confusion among the data sets we have built thus far.[10]). In the same DATA step, each inventory number is multiplied by its associated transition rates, giving the predicted future inventory (see Figure 6). However, this new inventory is broken down into a hodgepodge of repeating MOSGRADES because many of the transitions

[10] See Appendix, lines 203–206, 233–239, 293-297, and 326–333.

contained the same "To:" MOS and grade combination. In order to rectify this, the PROC MEANS function is applied which sums the inventory by like MOSGRADE2004s.[11] The resulting data set is a one-year-out forecasted inventory of Marines by MOS and grade with the exception of potential re-enlistees and accessions.

It is important to note that up to this point, the model has produced not one, but two forecasted inventory vectors. One of these represents first-term Marines and the other represents subsequent-term Marines. In the code, the first termers are processed first, followed by the subsequent termers. This allows the model to distribute the calculated number of required reenlistments between the first and the subsequent termers. Applying this distribution is not within the scope of this thesis.

Figure 6. Calculating Predicted Inventory

Current Inventory
20 - 3052E7s

(Beginning of FY2005)

X

Transition	Transition Rates
3052E7 to 3052E7	0.80
3052E7 to 3052E8	0.10
3052E7 to 9999E8	0.10

=

Forecasted 2005 Inventory
16 - 3052E7s
2 - 3052E8s
2 - 9999E8s

(End of FY2005)

4. Adding New Accessions to the Forecast Using SAS

The forecasted inventory of Marines not eligible to reenlist would be incomplete if the predicted number of new Marine accessions were not included. As a placeholder in the initial run of the model, we used a procedure similar to the one used to develop the inventory vectors, only this time we subseted the

[11] See Appendix, lines 261–265 and 355–359.

longitudinal data set on the NEWBIE2004 data field.[12] Simply put, in the absence of other information we assumed the number and distribution of new Marines for the upcoming year is the same as the year prior. However, when the model is run by manpower planners at M&RA, the actual predicted number of new accessions should be used.

The three forecasted inventories—first-term Marines, subsequent-term Marines, and newly acquired Marines—must be joined to get a total enlisted force (minus potential re-enlistees). This is done by simply stacking the data contained in the three data sets and then summing by like MOS and grade combination (called “ENDMG” in the SAS code).[13]

5. Transforming the GAR Using SAS

Next, the GAR must be input in a format against which the model’s forecasted inventory can be compared. This requires several SAS DATA steps and a PROC TRANSPOSE.[14] The end state is a two column data set that represents the 2005 GAR inventory. One of the columns is MOSGRADE and the other is the associated GAR inventory.

6. Calculating the Required Number of Reenlistments Using SAS

Finally, the newly created GAR inventory data set is merged with the forecasted non-reenlisting inventory data set and the corresponding MOSGRADE inventories are subtracted ({GAR inventory} – {forecasted inventory}). Figure 4 displays the methodology from beginning to end. This results in the number of reenlistments necessary to fit the future force requirement which was the ultimate goal of this thesis.

C. SUMMARY

In summary, this chapter covered took two looks at the methodology used to by the model. The first was from a theoretical point while the second was from the perspective of a SAS programmer. It is important to note that the underlying mathematics is same for either explanation.

[12] See Appendix, lines 367–370.

[13] See Appendix, lines 405–410.

[14] See Appendix, lines 438–503. A portion of this code was received from Captain S. Doheney, USMC, an analyst at M&RA.

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V. MODEL RESULTS

The model's output is designed to assist an experienced manpower analyst in developing a plan for the following fiscal year's reenlistments. Along with the decision of how many reenlistments there should be, the manpower analyst also must determine where to apply reenlistment bonuses and lateral transfers in order to ensure that manpower shortfalls are kept to a minimum. The results of this model assist him or her in all of these endeavors.

An example of the output can be found in Table 3. It contains the results of the model for each of the MOS and grade combinations in the 01 occupational field. The column labeled "ENDMG" holds the MOS and grade combination; "S_FINALCOUNT" represents the total forecasted inventory of Marines who are not in a reenlistment contract year; "GARcount" is the future force requirement taken from the GAR; and "REQREENLIST" is the number of required reenlistments to meet the GAR requirement. Given in this format, the output allows user to make conclusions such as the following.

- The fact that 250 reenlistments are needed in the 0151E3 MOS and grade combination means that a lateral transfer could be offered to the Marines in the 0161E3 MOS and grade combination, since it is overmanned. Alternatively, an SRB multiple could be applied to the 0151E3 MOS and grade combination which would likely cause more reenlistments.
- Because the difference for the 0161E3 MOS and grade combination is negative, boat spaces for that combination should be limited.
- The 0121 and 0151 MOSs feed into the 0193 MOS at the E-6 grade. This means that some of the reenlisting E-5s in the 0121 and 0151 MOSs will fill the 0193E6 MOS and grade combination

during their next contract. This is something for manpower planners to keep in mind when making final reenlistment recommendations.

These are just a few inferences that can be made on the particular output contained in Table 3. There is much more that could be gained by examining the model's output in its entirety.[15]

Table 3. Example Output

ENDMG	S_FINALCOUNT	GARcount	REQREENLIST
0121E3	1095	1381	286
0121E4	499	653	154
0121E5	347	492	145
0151E3	1075	1325	250
0151E4	688	825	137
0151E5	545	702	157
0161E3	203	168	-35
0161E4	63	88	25
0161E5	51	71	20
0161E6	39	50	11
0161E7	13	26	13
0161E8	5	9	4
0161E9	1	3	2
0193E6	597	925	328
0193E7	322	549	227
0193E8	86	174	88
0193E9	22	54	32

Notice that some of the numbers of reenlistment are negative. This does not necessarily mean that there should be zero (or negative) reenlistments in that particular MOS and grade combination. For Marines in the first term, this means that boat spaces will be limited (not zero). Accepting zero reenlistments for a particular MOS can result in promotion stagnation in the more distant future as well as manpower shortfalls during the following few years. On the other hand, for subsequent-term Marines, a negative output simply means that they will not

[15] The name of the output file for this particular run of the model is called "reenlistrequired.sas7bdat." See Appendix, lines 523–526, for the code that makes this data set.

be pressured by their occupational field sponsor to submit a reenlistment package. Recall that, first-term Marines can be turned down for reenlistment, while subsequent termers have protection as a result of Congressional legislation.

Just as allowing zero reenlistments may cause future MOS flow issues, so does authorizing too many reenlistments in a particular year. Currently, there is a limit on how many (or few) boat spaces can be made available for first termers. The rule of thumb used by manpower planners is that the number cannot change by more than 20 percent from one year to the next. This prevents any large fluctuations in the number of Marines in a particular MOS and grade combination and it maintains future stability among the higher grades. Hence, because of this rule of thumb, manpower planners who use this model with the intent of distributing the total number of reenlistments among the first and subsequent term must consider the previous year's boat space decisions when determining the first-term numbers.

The most important thing that a manpower analyst should recognize when examining the results of this model is that the numbers are based on several assumptions and therefore should not be taken as law. This, like all models, is a tool that can assist decision makers in making a reasonable choice when dealing with uncertainties. Good judgment must accompany any decision that involves shaping the manpower structure.

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VI. CONCLUSIONS AND RECOMMENDATIONS

In summary, the model described in this thesis provides Marine Corps manpower planners a method of determining the number of reenlistments necessary to meet a one-year-out enlisted force requirement. First, MOS and grade transition rates are determined. Then, the transition rates are applied to the current MOS and Grade inventory resulting in a predicted inventory of Marines. Finally, the forecasted inventory is compared to the GAR and the number of required reenlistments follows.

The advantage this model has over the current models is that it examines the entire enlisted force when making its calculations. As well, the model uses a software language with which M&RA manpower planners are familiar, thus making it easy to enhance or modify in order to meet changing manpower policies. This characteristic also makes the model capable of interacting with other SAS-based models used at M&RA.

The model, in its current state, does have limitations. It only projects the enlisted force one year into the future and it only uses a single prior year's transition rates to compute its forecast. It is likely that improvements in both of these areas would offer manpower planners even more insight in shaping the enlisted force. It is for this reason that emphasis should be placed on the following research topics.

- Evaluate whether using multiple prior years of data to calculate the transition rates improves the prediction, where the transition rates from those prior years could be combined by using:
    - overall mean of like transitions rates,
    - exponential smoothing of transition rates over time, or
    - weighted average of the transition rates.

- Similarly, determine if and when aggregating some MOSs by occupational field, particularly for small MOSs, improves model predictions.
- Enhance this model by incorporating various policy constraints mandated by the Department of Defense and M&RA.
- This model is designed to predict one year out. Determine how to modify the methodology to make predictions further into the future.
- Develop a nonlinear programming-based model that would use the output of this model and optimize the allocation of the SRB Program’s budget.

APPENDIX *SAS SYSTEM* CODE

The following is the *SAS System* code used to build the model that calculates the necessary number of reenlistments. For obvious reasons, it must be modified in order for it to calculate results for a different year.

```

/*****************************************************************
Author: Dave Raymond
Purpose: To calculate the number of reenlistments necessary to meet a
             future force.
*****************************************************************/

libname Demo 'Z:\R';
options YEARCUTOFF = 1950 ERRORS = 5K;

* IMPORT DBF FILES TO SAS DATA SETS;

%let LIST = 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005;
%MACRO GATHER;
%DO I= 1 %TO 11;
%LET YR = %SCAN(&LIST, &I);
PROC IMPORT OUT = Demo.data&YR
                  DATAFILE = "Z:\Demogr\FY&YR..dbf"
                  DBMS=DBF REPLACE;
                  GETDELETED = NO;
RUN;
PROC SORT DATA = Demo.data&YR OUT = Demo.sort&YR NODUPKEY;
      BY SSN;
RUN;
%END;
;
%MEND;
%GATHER;

* USE MACRO 'NAMER' (WITH UPDATED LIST) TO RENAME THE TFDW FIELDS BY YEAR
AND DROP UNWANTED FIELDS;
* These fields were dropped because initially the analysts weren't certain
which fields were going to be good;

%let LIST = 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005;
%MACRO NAMER;
%DO I = 1 %TO 11;
%LET YR = %SCAN(&LIST, &I);
DATA Demo.refine&YR (rename=(PRESENT_GR=GRADE&YR PRIMARY_MO=PMOS&YR
                            EXPIRATIO2=ECC&YR));
     SET Demo.sort&YR (DROP = PRESENT_RE PRIOR_CONT PROFICIENC PROFICIEN2
                              PROFICIEN3 REENLISTME PHYSICAL_F PHYSICAL_2
                              PRIOR_PHYS PRIOR_PHY2 WEIGHT_CON ADDL_FIRST
                              ADDL_SECON COMPONENT_ STRENGTH_C PLANNED_R3
                              PLANNED_R4 GRADE_SELE LAST_NAME FIRST_NAME
```

```
                                  BILLET_MOS CURRENT_AC GEOGRAPHIC GEOGRAPHI2
                                  PRESENT_MO OCCFIELD ECC_EAS_FL DUTY_STATU
                                  RECORD_STA MARITAL_ST NUM_DEPEND CURRENT_SO
                                  CURRENT_EN CRISIS_COD CRISIS_PAR EXPIRATION
                                  PLANNED_RE PLANNED_R2 SELECTIVE_ INITIAL_AC
                                  PAY_ENTRY_ AFQT_SCORE ARMED_FORC DATE_ENLIS
                                  ETHNIC_GRO INTENDED_M RACE SEX YOS);
RUN;
%END;
%MEND NAMER;
%NAMER;

* NEXT MACRO 'JOINEMUP' MERGES ALL END-OF-YEAR TFDW DEMOGRAPHIC DATA SETS
INTO ONE LARGE LONGITUDINAL DATA SET.  VARIABLES ARE INDEXED BY YEAR
ALREADY;

%let LIST = 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005;
%MACRO JOINEMUP;
DATA Demo.joinem;
      MERGE %DO J=1 %TO 11;
                  %LET YR = %SCAN(&LIST, &J);
                  Demo.refine&YR (in=Indata&YR)
                  %END;
      ;
      BY SSN;
RUN;
%MEND JOINEMUP;
%JOINEMUP;

*THE FOLLOWING CODE MAKES THE VARIABLES NEEDED FOR THE MODEL;

DATA Demo.joinem2;
      SET Demo.joinem;

lastday1995 = '30sep1995'D;
lastday1996 = '30sep1996'D;
lastday1997 = '30sep1997'D;
lastday1998 = '30sep1998'D;
lastday1999 = '30sep1999'D;
lastday2000 = '30sep2000'D;
lastday2001 = '30sep2001'D;
lastday2002 = '30sep2002'D;
lastday2003 = '30sep2003'D;
lastday2004 = '30sep2004'D;
lastday2005 = '30sep2005'D;


ARRAY ECC[*]      ECC1995-ECC2005;

ARRAY PMOSX[*]    PMOS1995-PMOS2005;

ARRAY GRADE[*]    GRADE1995-GRADE2005;

ARRAY ECCFY[*]    ECCFY1996 ECCFY1997 ECCFY1998 ECCFY1999 ECCFY2000
                  ECCFY2001 ECCFY2002 ECCFY2003 ECCFY2004 ECCFY2005;

ARRAY NEWBIE[*]   NEWBIE1996 NEWBIE1997 NEWBIE1998 NEWBIE1999 NEWBIE2000
```

```
                      NEWBIE2001 NEWBIE2002 NEWBIE2003
                      NEWBIE2004 NEWBIE2005;

ARRAY TRANSITION[*] $15. TRANSITION1996 TRANSITION1997 TRANSITION1998
                         TRANSITION1999 TRANSITION2000 TRANSITION2001
                         TRANSITION2002 TRANSITION2003 TRANSITION2004
                         TRANSITION2005;

ARRAY MOSGRADE[*] $6. MOSGRADE1996 MOSGRADE1997 MOSGRADE1998 MOSGRADE1999
                       MOSGRADE2000 MOSGRADE2001 MOSGRADE2002 MOSGRADE2003
                       MOSGRADE2004 MOSGRADE2005;

ARRAY ECCFYTEST[*] ECCFYTEST1996 ECCFYTEST1997 ECCFYTEST1998 ECCFYTEST1999
                   ECCFYTEST2000 ECCFYTEST2001 ECCFYTEST2002 ECCFYTEST2003
                   ECCFYTEST2004 ECCFYTEST2005;

DO K = 1 TO 10;
      IF ECC[K] > lastday1995 AND ECC[K]<= lastday1996
            THEN DO; ECCFY1996 = 1; ECCFYTEST1996 = 1; END;
      IF ECC[K] > lastday1996 AND ECC[K]<= lastday1997
            THEN DO; ECCFY1997 = 1; ECCFYTEST1997 = 1; END;
      IF ECC[K] > lastday1997 AND ECC[K]<= lastday1998
            THEN DO; ECCFY1998 = 1; ECCFYTEST1998 = 1; END;
      IF ECC[K] > lastday1998 AND ECC[K]<= lastday1999
            THEN DO; ECCFY1999 = 1; ECCFYTEST1999 = 1; END;
      IF ECC[K] > lastday1999 AND ECC[K]<= lastday2000
            THEN DO; ECCFY2000 = 1; ECCFYTEST2000 = 1; END;
      IF ECC[K] > lastday2000 AND ECC[K]<= lastday2001
            THEN DO; ECCFY2001 = 1; ECCFYTEST2001 = 1; END;
      IF ECC[K] > lastday2001 AND ECC[K]<= lastday2002
            THEN DO; ECCFY2002 = 1; ECCFYTEST2002 = 1; END;
      IF ECC[K] > lastday2002 AND ECC[K]<= lastday2003
            THEN DO; ECCFY2003 = 1; ECCFYTEST2003 = 1; END;
      IF ECC[K] > lastday2003 AND ECC[K]<= lastday2004
            THEN DO; ECCFY2004 = 1; ECCFYTEST2004 = 1; END;
      IF ECC[K] > lastday2004 AND ECC[K]<= lastday2005
            THEN DO; ECCFY2005 = 1; ECCFYTEST2005 = 1; END;
END;

DO M = 1 TO 10;
      *Back-fills the non-one ECCFYTEST&yr fields with zeros;
      IF ECCFYTEST[M]=. THEN ECCFYTEST[M]=0;
      *Checks for Assessions;
      IF PMOSX[M]='' AND PMOSX[M+1]~='' THEN NEWBIE[M]=1;
      *Makes the MOSGRADE&yr field;
      MOSGRADE[M] = PMOSX[M+1]||GRADE[M+1];
      *Makes the TRANSITION&yr field;
      IF PMOSX[M]~='' AND GRADE[M]~=''
            THEN TRANSITION[M] =
            PMOSX[M]||GRADE[M]||'to'||PMOSX[M+1]||GRADE[M+1];
END;

DO P = 1 TO 10;
*Back-fills NEWBIE&yr field for Marines in the system at the time;
      IF NEWBIE[P]=. AND PMOSX[P+1]~='' THEN NEWBIE[P]=0;
END;
```

```
*The following variables are going to be used to determine whether a Marine
is a first termer or a Subsequent termer;

ECCTOTAL05 = SUM(ECCFYTEST1996, ECCFYTEST1997, ECCFYTEST1998,
                 ECCFYTEST1999, ECCFYTEST2000, ECCFYTEST2001,
                 ECCFYTEST2002, ECCFYTEST2003, ECCFYTEST2004,
                 ECCFYTEST2005);

ECCTOTAL04 = SUM(ECCFYTEST1996, ECCFYTEST1997, ECCFYTEST1998,
                 ECCFYTEST1999, ECCFYTEST2000, ECCFYTEST2001,
                 ECCFYTEST2002, ECCFYTEST2003, ECCFYTEST2004);

ECCTOTAL03 = SUM(ECCFYTEST1996, ECCFYTEST1997, ECCFYTEST1998,
                 ECCFYTEST1999, ECCFYTEST2000, ECCFYTEST2001,
                 ECCFYTEST2002, ECCFYTEST2003);

DROP lastday1995-lastday2005 K M P ECCFYTEST1996-ECCFYTEST2005;
RUN;

*Builds the first-term subset of Marines who are not eligible for
reenlistment;

DATA Demo.Ftapnotelig2004;
      SET Demo.joinem2;
      IF ECCFY2004 ~=1 AND PMOS2003~='' AND ECCTOTAL03=0;
RUN;

PROC SORT DATA = Demo.Ftapnotelig2004;
      BY MOSGRADE2003;
RUN;

/*The "Percent of Total Frequency" field in the output file below titled,
"Demo.Ftapnotelig04" is the transition rate associated with the
"Transition" from the previous year's MOSGRADE*/

PROC FREQ DATA=Demo.Ftapnotelig2004 NOPRINT;
      BY MOSGRADE2003;
      TABLES Transition2004 / OUT = Demo.Ftapnotelig04;
RUN;

*Creates starting MOSGRADE and ending MOSGRADE fields;
DATA Demo.Ftapnotelig04;
      SET Demo.Ftapnotelig04;
      STARTMG = TRIM(SUBSTR(Transition2004,1,6));
      ENDMG = TRIM(SUBSTR(Transition2004,10,6));
run;

*sort for merge;
PROC SORT DATA = Demo.Ftapnotelig04;
      BY STARTMG;
RUN;
*NEW TASK:  CREATE N VECTOR (INVENTORY) OF NOT ELIG FIRST TERMERS at
beginning of FY2005;
*THE FOLLOWING DATA STEP SIMPLY FILTERS THE DATA FOR THE INDIVIDUALS WE’RE
LOOKING FOR—FIRST TERM, NOT ENTERING A CONTRACT YEAR;
DATA Demo.vecFtapnotelig05;
      SET Demo.joinem2;
```

```
      IF ECCFY2005 ~=1 AND PMOS2004~='' AND ECCTOTAL04 = 0;
RUN;

*SORT INVENTORY OF FTAPNOTELIG;
PROC SORT DATA = Demo.vecFtapnotelig05 OUT = Demo.Ftapnotelig05sort;
      BY MOSGRADE2004;
RUN;

*GET INVENTORY BY MOSGRADE AT END OF '04 WHO ARE NOT ELIG FOR '05 REEN;
PROC FREQ DATA = Demo.Ftapnotelig05sort NOPRINT;
      TABLES MOSGRADE2004 / OUT = Demo.Ftapnoteligvec05;
RUN;

*RENAME 2 INVENTORY VAR NAMES FOR FIRST-TERM NOTELIG VARIABLES FOR MERGE*;
DATA Demo.Ftapnoteligvec05;
     SET Demo.Ftapnoteligvec05 (rename = (MOSGRADE2004=STARTMG
                                          COUNT=NVECTOR));
      DROP PERCENT;
      LABEL NVECTOR = 'NVECTOR'
            STARTMG = 'STARTMOSGR';
RUN;

PROC SORT DATA = Demo.Ftapnoteligvec05;
      BY STARTMG;
RUN;

* APPLY RATES OF MOVEMENT TO VECTOR OF NOT ELIG MARINES.  NOTICE THE DATA
SET NAMES THAT ARE BEING MERGED;
DATA Demo.fin_FTAPNOT;
      MERGE Demo.Ftapnoteligvec05 Demo.Ftapnotelig04;
      BY STARTMG;
      IF PERCENT=. THEN PERCENT=0.0;
      PERCENT=PERCENT/100;
      newN=NVECTOR*percent;
      IF newN = . THEN newN=0;
RUN;

PROC SORT data=Demo.fin_ftapnot;
      by ENDMG;
RUN;

* Now sum up the number of personnel for the "MOSGRADE04" categories;
PROC MEANS data=Demo.fin_ftapnot SUM NOPRINT;
      BY ENDMG;
      VAR newN;
      OUTPUT OUT=Demo.ftapnotsummary SUM=Finalcount;
RUN;

/*****************************************
END FIRST-TERM NOT ELIGIBLES
****************************************/
*****************************************
/*****************************************
START SUBSEQUENT TERM NOT ELIGIBLES
****************************************/

*Builds the subsequent-term subset of Marines who are not eligible for
```

```
reenlistment;
DATA Demo.Stapnotelig2004;
      SET Demo.joinem2;
      IF ECCFY2004 ~=1 AND PMOS2003~='' AND ECCTOTAL03 > 0;
RUN;

PROC SORT DATA = Demo.Stapnotelig2004;
      BY MOSGRADE2003;
RUN;

*GET TRANSITION RATES FROM '03 TO '04*******;
PROC FREQ DATA=Demo.Stapnotelig2004 NOPRINT;
      BY MOSGRADE2003;
      TABLES Transition2004 / OUT = Demo.Stapnotelig04;
RUN;

*ADD 'FROM' AND 'TO' INFO BACK ONTO PROC FREQ OUTPUT*****;
DATA Demo.Stapnotelig04;
      SET Demo.Stapnotelig04;
      STARTMG = SUBSTR(Transition2004,1,6);
      ENDMG = SUBSTR(Transition2004,10,6);
RUN;

DATA Demo.Stapnotelig04;
      SET Demo.Stapnotelig04;
      STARTMG = TRIM(STARTMG);
      ENDMG = TRIM(ENDMG);
RUN;

*sort for merge;
PROC SORT DATA = Demo.Stapnotelig04;
      BY STARTMG;
RUN;

*NEW TASK: CREATE N VECTOR OF NOT ELIG SUBSEQUENT TERMERS;
DATA Demo.vecStapnotelig05;
      SET Demo.joinem2;
      IF ECCFY2005 ~=1 AND PMOS2004~='' AND ECCTOTAL04 > 0;
RUN;

PROC SORT DATA = Demo.vecStapnotelig05 OUT = Demo.Stapnotelig05sort;
      BY MOSGRADE2004;
RUN;

*GET INVENTORY BY MOSGRADE AT END OF '04 OF THOSE WHO ARE NOT ELIG FOR '05
REEN;
PROC FREQ DATA = Demo.Stapnotelig05sort NOPRINT;
      TABLES MOSGRADE2004 / OUT = Demo.Stapnoteligvec05;
RUN;
*RENAME 2 INVENTORY VAR NAMES FOR SUBSEQUENT NOTELIG VARIABLES FOR MERGE*;
DATA Demo.Stapnoteligvec05;
      SET Demo.Stapnoteligvec05 (rename = (MOSGRADE2004=STARTMG
                                           COUNT=NVECTOR ));
      STARTMG = TRIM(STARTMG);
      DROP PERCENT;
      LABEL NVECTOR = 'NVECTOR'
            STARTMG = 'STARTMOSGR';
```

```
      RUN;

**SORT FOR MERGE WITH TRANSITION RATES;
PROC SORT DATA = Demo.Stapnoteligvec05;
      BY STARTMG;
RUN;

* APPLY RATES OF MOVEMENT TO VECTOR OF NOT ELIG MARINES;
DATA Demo.fin_STAPNOT;
      MERGE Demo.Stapnoteligvec05 Demo.Stapnotelig04;
      BY STARTMG;
      IF PERCENT=. THEN PERCENT=0.0;
      PERCENT=PERCENT/100;
      newN=NVECTOR*PERCENT;
      IF newN = . THEN newN = 0;
      RUN;

PROC SORT DATA=Demo.fin_stapnot;
      BY ENDMG;
RUN;

* Now sum up the number of personnel for the "MOSGRADE04" categories;
PROC MEANS DATA=Demo.fin_stapnot SUM NOPRINT;
      BY ENDMG;
      VAR newN;
      OUTPUT OUT=Demo.stapnotsummary SUM=Finalcount;
RUN;

/**************************************
END SUBSEQUENT-TERM NOT ELIGIBLES
**************************************/

*BRING IN ACTUAL 2004 NEWBIES SINCE WE HAVE NOT ACCOUNTED FOR ACCESSION

PROC FREQ DATA = Demo.JOINEM2;
      WHERE NEWBIE2004 = 1 AND GRADE2004 IN ('E1' 'E2' 'E3' 'E4');
      TABLE MOSGRADE2004 / OUT = Demo.accessions04;
RUN;

*RENAME MOSGRADE2004 IN ACCESSION DATA;
DATA Demo.accessions04;
      SET Demo.accessions04 (rename = (MOSGRADE2004 = ENDMG  COUNT =
                                       FINALCOUNT));
      DROP PERCENT;
RUN;

*BRING IN NEWBIES WHERE GRADE > E2 BECAUSE GAR DOESN'T HAVE NUMBERS FOR E1
OR E2 SO THERE'S NOTHING WITH WHICH TO COMPARE;
DATA Demo.noteligaccessions;
      SET Demo.accessions04;
      IF SUBSTR(ENDMG,5,2) NOT IN ('E1' 'E2');
RUN;

PROC SORT DATA = Demo.noteligaccessions;
BY ENDMG;
RUN;

```

```
/***************************************************
END NEWBIE VECTOR FORMULATION (ABOVE)
****************************************************
BUILD FORECASTED TOTAL INVENTORY (BELOW)
***************************************************/

DATA Allnoteligible;
      SET Demo.stapnotsummary Demo.Ftapnotsummary Demo.noteligaccessions;
      DROP _FREQ_  _TYPE_;
RUN;

PROC SORT DATA = Allnoteligible;
      BY ENDMG;
RUN;

PROC MEANS DATA = Allnoteligible SUM NOPRINT;
      VAR FINALCOUNT;
      BY ENDMG;
      WHERE SUBSTR(ENDMG,5,2) NOT IN ('E1' 'E2');
      OUTPUT OUT = Demo.Allnoteligtotals SUM = S_FINALCOUNT;
RUN;

DATA Demo.Allnoteligtotals;
      SET Demo.Allnoteligtotals;
      DROP _TYPE_ _FREQ_;
RUN;

/***************************************************
END FORECASTED TOTAL INVENTORY VECTOR FORMULATION (ABOVE)
****************************************************


/**********************************************************************STAR
T OF CODE WRITTEN BY CAPTAIN SHAUN DOHENEY, AN ANALYST AT HQMC, M&RA.  THIS
CODE INITIATES THE TRANSFORMATION OF THE GAR INTO A FORMAT THAT CAN BE
COMPARED TO THIS MODEL'S OUTPUT.
**********************************************************************/

***********************************************************************
INFILE PATH             Z:\R
INFILE NAME             fy05gbl.txt (this is a .gbl file that has been
identified as a .txt file)
OUTFILE PATH            Z:\R
OUTPUT FILE NAME  fy05GARgbl.txt
**********************************************************************;
/* WARNING: This DATA step produces a lot of "NOTE:" 's. We had to put
ERRORS=5K in the first few lines of code (above) to accommodate for
these.*/
DATA PROCESSING;
      INFILE 'Z:\R\fy05gbl.txt';
      INPUT MOS $ 2-6
            Plan $ 7-23
            E9    26-29
            E8    32-35
            E7    38-41
            E6    43-47
            E5    49-53
```

```
              E4    55-59
              E3    61-65
              E2    69-72
              Total 73-78;
RUN;

DATA PROCESSING(rename=(MOS2=MOS));
      RETAIN MOS2;
      SET PROCESSING;
      BY MOS NOTSORTED;
      IF first.MOS and MOS ne '' THEN MOS2=MOS;
      DROP MOS;
      IF Plan NE 'GAR' THEN DELETE;
      OCCFLD = SUBSTR(MOS2,3,2);
      GONE = SUBSTR(MOS2,1,2);
      IF OCCFLD = '00' THEN DELETE;
      IF GONE = 'OF' THEN DELETE;
      DROP OCCFLD GONE PLAN;
      *DROP GONE;
      *DROP Plan;
RUN;
PROC SORT DATA=PROCESSING;
      BY MOS;
RUN;
/***********************************************************************THIS
ENDS CAPTAIN DOHENEY'S CODE.
**********************************************************************/

*THE FOLLOWING CODE FINISHES PUTTING THE GAR DATA INTO A FORMAT THAT CAN BE
COMPARED TO THE OUTPUT FROM THE CFRM MODEL.

DATA Demo.garfy05;
      SET PROCESSING;
      DROP TOTAL;
RUN;

PROC TRANSPOSE DATA=Demo.garfy05 OUT=Demo.garfy05a(RENAME=(COL1=COUNT));
      BY MOS;
      VAR E9 E8 E7 E6 E5 E4 E3 E2;
RUN;

DATA Demo.garfy05;
      SET Demo.garfy05a (RENAME=(_NAME_=GRADE));
      IF GRADE ~= 'E2';
      LABEL GRADE="GRADE";
      MOSGRADE=TRIM(MOS)||TRIM(GRADE);

RUN;

DATA Demo.getGAR;
      SET Demo.garfy05(rename = (MOSGRADE = ENDMG COUNT = GARcount));
      IF GRADE NOT IN ('E1' 'E2');
RUN;

PROC SORT DATA = Demo.getGAR;
      BY ENDMG;
RUN;
```

```
/**********************************************************************COMP
ARE TO GAR TO GET NUMBER REQUIRED REENLISTMENTS
**********************************************************************/

*****GIVES REQUIRED # REENLISTMENTS. SOME MOSGRADE COMBOS WE CAN'T PREDICT
(MOSTLY ENDING IN '00');

DATA Demo.reenlistrequired;
      MERGE Demo.Allnoteligtotals Demo.getGAR;
      BY ENDMG;
      IF GARCOUNT = . THEN GARCOUNT = 0;
      IF S_FINALCOUNT = . THEN S_FINALCOUNT =0;
      IF GARCOUNT=0 AND S_FINALCOUNT=0 OR ENDMG ='' THEN DELETE;
      REQREENLIST = GARcount - S_FINALCOUNT;
      DROP MOS GRADE;
RUN;

*Cleans-up the output data set;
DATA Demo.reenlistrequired;
      SET Demo.reenlistrequired;
      LABEL S_FINALCOUNT = "PREDICTED COUNT" ENDMG = "MOSGRADE";
RUN;

* THE DATA SET TITLED “Demo.reenlistrequired” is the final output of the
model.

Quit;
```

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